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PLANT PATHOLOGY IN ITS RELATIONS TO OTHER SCIENCES

IN the naming of this association of scientists, The Illinois Academy of Science,[1] there was recognized a very subtle tendency in advancing civilization and modern educational thought. It has often been noted that as civilization becomes more highly developed, it also becomes more complicated, and men become more dependent upon one another. So, too, as knowledge increases in volume and in extent, the fields of study which were formerly quite independent grow closer together, and, new fields opening up, find themselves involved with many others already existing. We are finding, in fact, that knowledge is a unit—not a mere assemblage of disconnected ideas, so that it is advantageous, now and then, to examine a new science, and to discover, in so far as we can, with what other parts of the body of science it may be intimately related. Therefore, it has seemed advisable to consider, this morning, how plant pathology is related to other sciences.

Plant pathology is one of the youngest, and perhaps one of the least understood, of the recently developed sciences. When considered in its broadest meaning, it is for plants, as medical science is for man, a study of the normal, and of the diseased conditions of the organism. In the narrower and more widely accepted sense, however, it deals with the abnormalities

[1] This paper was read before the academy at its first regular meeting, held at Decatur, Illinois, February 22, 1908.

both of form and of function, which in animals are, and in plants may be, called diseases. There is one other phase also which must always appear, that of the prevention and the cure of the maladies.

Few people who have not studied the matter realize the very large loss of money occasioned each year by these plant diseases, and fewer yet know that much has already been done to diminish this loss, and much more will be done when more scientific and detailed study is carried on by a larger number of investigators scattered widely over the country. A conservative estimate of the loss caused by the bitter rot of apples throughout the country each year, is ten millions of dollars. In the state of Illinois, the loss, due to corn rot, for the past year, is estimated at perhaps two hundred and eighty thousand dollars. But we want to know what may be done to reduce such losses. It is a part of the work of the plant pathologist to discover how this may be done, and for many diseases a remedy has been found.

By proper spraying methods, on a commercial scale, ninety per cent. of the loss from peach yellows has been saved. Oat smut has nearly lost its terrors for the scientific farmer, because of the method of "seed" treatment which kills the smut spores. In New York a properly sprayed vineyard gave a net profit of over fifteen hundred dollars more than the same vineyard, unsprayed, yielded the previous year. Diseases of various origins have been treated and the loss caused by them has been materially reduced. Moreover, the importance of this work is increasing with the growing population, for crops are becoming more extensive and crowded, a condition which gives two of the important factors that tend to produce great epidemics of diseases.

The science of plant pathology, like bacteriology, is very closely related to botany, and in a broad classification of the sciences would be considered a part of that great subject. Yet, with equal justice, it may be considered as a separate science, closely related, first to botany, then to zoology, chemistry and physics.

The affiliations with botany are varied and strong. If we consider those diseases which are caused by parasitic fungi, as rusts, mildews and so forth, or by bacteria, as many "wilts" of garden plants, or even by the parasitic flowering plants, such as the dodder and the mistletoe, we must first know the names and the systematic relations of these invading organisms. Here at the outset we come in touch with that great department of the science, systematic botany, which, for very many years, engaged the entire attention of botanists.

Hand in hand with this first part of the investigation goes the study of the morphology of the parasite, for to determine the name we must know the peculiarities of form and of structure which distinguished it from all of its relatives. Moreover, the parasite, if it grows on two or more different plants, may show various modifications of its own form, according to the plant on which it happens to develop. Thus, the common grain rust, *Puccinia graminis,* when growing on its alternate host-plant, the barberry, produces entirely different kinds of spores from those on the grains. Pathology and morphology cross paths also at another point. A large and important field of study now being developed is that of the correlation of the natural structure of the plant attacked, with the modifications due to the disease. This work is essential for two reasons. We may thus learn, in regard to diseases caused by organic beings, in what manner the parasite attacks and destroys the host-plant. A disease, however, may not be caused by an organism,

but may result from certain known or unknown improper physical conditions of the plant's environment. Hence this study may result in a better differentiation between these so-called "physiological diseases," and the derangements caused by parasites.

Plant physiology is no less important in the study of plant diseases than morphology. We must know the normal functions of the plant attacked, and be able to realize in what way they have been deranged. Thus, if a parasite is the cause of the disease, it may bring about the death of the host-plant in one or more of the following ways: It may strangle the plant by clogging the water-conducting vessels, as in the bacterial "wilt" of melons, already referred to. Again, it may give out a poison which kills the protoplasm of the cells affected, as De Barry describes for one of the *Sclerotinia* diseases. The third method is by absorbing the food, water or the protoplasm itself, from the cells of the host. This seems, at the present time, to be the most common mode of attack, especially in those diseases, like leafspots, which remain localized in some organ. When an organism has the power of injuring more than one kind of plant, its own functions may be modified according to varying conditions. This is important in seeking means of curing or of preventing the disease. A good example is the common grain rust mentioned previously, which, though identical in form and appearance, on wheat, oats and rye, can not be taken from any one of the three hosts and grown on either of the others.

Plant pathology not only owes much to these departments of botany, but also to bacteriology. Laboratory methods which have been found useful in the latter have been adapted to the somewhat different needs of the former. The use of culture media, though not so absolutely necessary for elementary work in pathology as it is in bacteriology, is, however, very common, and, doubtless, special media for special organisms are more numerous here than in the allied science. Since Dr. Burrill, of the University of Illinois, demonstrated in 1879 that in one instance, at least, the pear blight, a plant disease might be caused by bacteria, many diseases have been shown to be of similar origin, and here, naturally, the pathologist becomes very closely allied with the bacteriologist.

Of more and more importance to the country is forestry, on which, eventually, large portions of the land must depend for rainfall and for timber. With this is closely allied our science of plant pathology. There are many diseases of trees, which, unless curbed, threaten the growing of forests. One need but to refer to the "punk" disease of the longleaf and of the shortleaf pines and to similar decays of other forest trees, to justify this claim. Indeed, this is so important that a forest pathologist has recently been appointed by the government to study these diseases more carefully. It is unnecessary to dwell upon the increasing importance of the science to agriculture, for we have already noted their close relation.

We have seen that botany in all its phases is intimately associated with the study of plant diseases, but now we will consider what other sciences have an interest in it.

We turn naturally to zoology as the science next to botany, and in many ways it may well be so considered. To plant pathology it is related chiefly through the pathological conditions which arise as a result of the attacks of various worms, insects and even higher animals. In this way, many galls, such as the well-known oak-galls and the nematode root-gall, which inflicts so much damage, originate. The stripping of the leaves from trees, and the

ever-present injuries to farm products cause conditions for pathological study. Many diseases are transferred from plant to plant by animals of nearly all classes, and the combined efforts of zoologists and of pathologists will be necessary to combat this evil. Dr. Erwin F. Smith enumerates bees, the potato beetle, snails and slugs as known transportation agents for various diseases. Moreover, we do not yet know how many diseases of animals, both domesticated and wild, may be due directly or indirectly to plant diseases. Cases have been reported where serious results have attended the feeding of diseased fodder to live stock; and flour, made from infested grain, may cause serious results in man.

The relations between plant pathology and chemistry are perhaps more intimate, but at first glance less apparent than those already noted. The most obvious connection is through the work which the chemist and the pathologist have done together in developing the manufacture and the use of fungicides. To the farmer, this has seemed the most practical side of pathological work, because of the immediate results in saving crops. A less noticeable but even more important contribution of chemistry is the analysis of soils and of fertilizers, by which we can better know the conditions of optimum growth for various crops, and the best conditions for growing plants which are resistant to disease. The good resulting from this kind of investigation can not be overestimated, for, as a man in good physical condition is able to resist the attacks of many diseases, so a plant, if given the best conditions for growth, will be able to combat the various parasitic organisms which would otherwise destroy it. In another way chemistry will prove in the future a valuable ally in studying plant diseases. In the healthy plant certain products of growth are formed whose chemical nature must be known. When the plant is diseased, these organic compounds, acted upon by the enzymes produced by the attacking organism, or otherwise changed in composition, must be examined again to determine the nature of the change.

The relations existing between plant pathology and physics are not so well defined as in the cases already cited. If, however, we keep in mind that there is, in the study of botany, a physical as well as a physiological side, these relations are more easily seen. The ascent of water in trees; the conduction of water, food-elements and foods, and reaction to gravitation and to other physical stimuli are problems which the physicist must aid us in solving, though connected with these there are undoubtedly many vital processes which modify the mere physical forces. In a diseased plant the effects of these physical forces are modified probably more than we now realize. We may mention as examples of these modifications the stoppage of water-conducting elements in woody plants, the weakening of the tenacity of wood, and similar changes in the physical conditions of plants.

This is not the place to state more definitely the problems in plant pathology waiting to be solved with the aid of other sciences, but we may note in closing that in the past the interrelations of the sciences have not been entirely disregarded, for such men as Pfeffer and Pasteur, by using methods of sister sciences, have made valuable additions to our knowledge of botany.

Ernest Shaw Reynolds

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
SECTION F—ZOOLOGY
THE AMERICAN SOCIETY OF ZOOLOGISTS
II

Inheritance of Comb Form in Poultry: C. B. Davenport, Carnegie Station for Ex-

perimental Evolution, Cold Spring Harbor, N. Y.

Genetics in Swine Hybrids: Q. I. and J. P. SIMPSON, Palmer, Ill.

In the year 1896 the writers began experiments with swine for economic results and for determining the relative potential of sex; but the uncovering of Mendel's laws has since broadened our inquiry.

The material has comprised nine pure and distinct breeds.

Two breeds, although of identical color, do not act alike under hybridization, showing a difference in their color determiners.

Combinations are made where coat color is full dominant, but skin color complete recessive, in the same animal.

We find the wild *sus scrofa* full dominant over every observable character and instinct of the Tamworth—even fooling the naturalists.

The solid hoof of the "Arkansas Mule Foot" is dominant over normal breeds; but intermediate grades of hoof are made at will.

Examples are shown of a transferrence of color, following shedding of the hair; of finely mingled roans; of segmented coloring of individual hairs (like the banded hairs of the wild Texas peccary), all showing that two colors may exist in the same cell—one of them passively awaiting its biochemic stimulus.

Instances are noted of the testes acting as this stimulus and, from the apparent mass of evidence, that color may exist in cells, unexhibited, is drawn a conception that seems to emasculate the "allelomorph to its absent" theory, now held by some renowned experimenters.

Of two red breeds, identical in tint, crossed with a white breed, one produces roans only; while the other makes only mosaics, showing that the first red breed is of solid color origin, and the last, of pattern origin. And the known history of each confirms this.

Color quantity in the individual is in ratio to the sum of its parents' colors.

A cause for the white belt in horse, swine, ox and India tapir is thought to be embryonic, and its more anterior location on swine is ascribed to blastomere divergence between these species.

Among the nine breeds used in hybrid experiments, it was discovered that some breeds would pair with equal color-potential. And the broods from these exhibit two distinct classes, equally divided, indicating the slightly inexact division of a chromosome in the oogenesis or spermatogenesis of a parent; and when confirmed by further experiment will show a fruitful cause for variation, within a breed or species.

We have found to be absolute, the Mendelian reseparation of units in swine color-hybrids.

When we say that with morphologic and color units the breeder may now add, combine and fuse, can extract, precipitate and analyze for purity—as with chemicals—that he may almost create designs at will, it is not said in egotism; but in profound acknowledgment to you men of science who show the way. And whilst the breeder's interest is not uppermost in your research of nature's evolution, his gratitude is none the less.

Report on Some Experiments in Transplanting Species of Leptinotarsa into new Habitats, with Remarks upon the Significance of the Mode: W. L. TOWER, University of Chicago.

Inheritance of Crest and Color in Canaries: C. B. DAVENPORT, Carnegie Station for Experimental Evolution, Cold Spring Harbor, New York. (Published in *Proceedings* of the Eastern Branch.)

A Litter of Short-tailed Dogs: R. M. Strong, The University of Chicago.

A fox-terrier bitch gave birth on October 31, 1907, to five pups—four males and one female. One of the males had practically no tail, and the other pups had short tails of various lengths. The tails were measured on November 28, as follows: The female and one male had tails measuring about 1¼ inches. A third male had a tail 2½ inches long, and the fourth male's tail measured 4 inches. The female and the tailless male are being reared for breeding studies. The mother's tail is short, and it has the appearance of having been cut at some time. The male parent is unknown, and the condition of the mother's tail at birth has not yet been satisfactorily determined.

Some Stages in the Embryology of certain Degenerate Phoridæ and the supposedly Hermaphroditic Genus Termitoxenia: Charles T. Brues, Public Museum, Milwaukee, Wisconsin.

The family Phoridæ form an interesting group of Diptera on account of a number of genera which are partially or wholly wingless in the female sex, and very degenerate in other respects.

The oogenesis of a species of the Texan myrmecophilous genus *Ecitomyia* was studied and compared with that of *Termitoxenia,* another form of aberrant Phoridæ which has been investigated by Wasmann. The resemblance is very close and serves to confirm the writer's opinion of the close relationship between *Termitoxenia* and other Phoridæ.

The gross features of the embryology of *Termitoxenia* were studied and found to present no remarkable divergence from the same stages in some other Diptera. They do not confirm the supposition of Wasmann that these insects give birth to the imago stage with a suppression of the larva and pupa, since the oldest embryos found are no farther advanced than those of certain viviparous flies like *Sarcophaga,* which give birth to living larvæ.

The writer could find no evidence in support of the hypothesis that these animals are hermaphroditic.

Suggestions for a Natural Classification of the Family Lymnæidæ: Frank Collins Baker, Chicago Academy of Sciences.

The fresh-water pulmonates have been gradually undergoing the splitting process so notably carried out in the land snails by Pilsbry, Dall and others. The family Lymnæidæ contained, until recently, the genera *Lymnæa, Planorbis, Physa* and *Ancylus,* besides several other small genera. *Ancylus* and *Physa* have been separated, forming the families Ancylidæ and Physidæ, each characterized by peculiarities of shell, radula and genitalia. Of the old Lymnæidæ there still remain *Lymnæa* and *Planorbis,* each falling into a sub-family. A study of these two groups seems to point inevitably to their separation into two families, Lymnæidæ and Planorbidæ, the former having a long-spired shell, a unicuspid central tooth, bi- or tri-cuspid lateral teeth, and the male genitalia with strong muscles protracting and retracting the male organ, which forms a distinct penis and penis sac. In Planorbidæ the shell is discoidal, the central tooth is bicuspid, the laterals are tricuspid, with a modified mesocome in the typical genus, and the male organ is destitute of the strong muscles of *Lymnæa* and is not strongly differentiated into penis and penis sac. In *Planorbis* the tentacles are long and filiform while in *Lymnæa* they are flat and triangular.[1]

As thus restricted, the Lymnæidæ present a homogeneous group of snails which may be divided into several genera and

[1] Pompholaginæ will probably also be found to rank as a family.

subgenera. Generic characters may be found in the genitalia (shape of prostate, relative size and form of penis and penis sac) the radula and the shell. It was found upon studying the genitalia that the groups *Radix, Megasoma, Galba* and *Acella,* which had been founded upon shell characters, could also be distinguished by differences in the genitalia.

Only the North American species have been critically examined;[2] the application of the above criteria results in the following tentative classification:

Family LYMNÆIDÆ Broderip. 1839
Subfamily Lymnæinæ Dall. 1870
Mantle margins retained within margin of shell.
Genus *Lymnæa* Lamarck. 1799. Type, *Helix stagnalis* Linné.
Genus *Pseudosuccinea* Baker, nov. Type, *Lymnæa columella* Say.
Genus *Radix* Montfort. 1810. Type, *Helix auricularia* Linné.
Subgenus *Polyrhytis* Meek. 1876. Type, *Limnæa kingii* Meek.
Genus *Bulimnea* Haldeman. 1841. Type, *Limnæa megasoma* Say.
Genus *Acella* Haldeman. 1841. Type, *Limnæa haldemani* (Desh.) Binney.
Subgenus *Pleurolimnæa* Meek. 1866. Type, *Limnæa tenuicostata* M. & H.
Genus *Galba* Schrank. 1803.
Subgenus *Galba* (typical). Type, *Buccinum truncatulatum* Müller.
Subgenus *Stagnicola* Leach. 1830. Type, *Buccinum palustre* Müller.
? Subgenus *Leptolimnæa* Swainson. 1840. Type, *Buccinum glaber* Müller.
Subfamily Amphipepliidæ Baker, nov.
Mantle margins enlarged, covering a portion of the shell.
Genus *Amphipeplea* Nilsson. 1822. Type, *Buccinum glutinosum* Müller.
Genus *Cyclolimnæa* Dall. 1905. Type, *Limnæa involuta* Harvey.

[2] Several foreign genera are not here included, as their anatomy is unknown. The study of these genera will not, it is believed, materially change the outline here presented.

Pigmentation in the Feather Germs of a White Ring-dove Hybrid: R. M. STRONG, University of Chicago. (Read by title.)

The Sense of Smell in Birds: R. M. STRONG, The University of Chicago.

This is a preliminary report of investigations that are not yet completed. The olfactory sense was studied in buzzards and ring-doves, but principally in the latter. The behavior of four ring-doves with reference to the odors of cologne, violet sachet powder, and oil of bergamot, was observed with the aid of a labyrinth. This apparatus was provided with four apartments opening into a central square enclosure. The doves were fed twice a day in one of these apartments which was chosen at random. An odor was driven out of the chamber containing the food, into the central enclosure, by a gentle air current. Similar air currents emerged from the other apartments as controls. An air exhaust was located at the center of the apparatus. The labyrinth was ventilated after each feeding, and this series of experiments has been continued for about three months.

A significant but not regular improvement in the accuracy of finding the food was observed. The conclusion reached is that birds may be stimulated by the odors employed, but it is also probable that little use is made of olfactory stimuli.

A morphological study of the olfactory apparatus of birds is in progress.

The Anatomy of a Typical Pennatulid: C. C. NUTTING, University of Iowa.

A demonstration with lantern slides of the use of photography of objects under water in illustrating the gross anatomy of an alcyonarian, and also the first detached

description of the structure of a pennatulid. (Monograph in progress.)

On the Distribution of Certain Salmonidæ in Wisconsin: GEORGE WAGNER, University of Wisconsin.

A discussion of the occurrence of the lake trout and certain Coregoni in Wisconsin, with special reference to the physical characters of the lakes concerned.

The Process of Heredity as Exhibited by the Development of Fundulus Hybrids: H. H. NEWMAN, University of Michigan.

In the spring of 1905 the writer, after familiarizing himself with the experimental work on heredity of the last decade or so, came to the conclusion that this work dealt too exclusively with definitive characters and scarcely at all with the origin and development of these characters. Being firmly convinced that heredity is essentially a developmental phenomenon, it seemed necessary to make a study of the process of heredity as exhibited in living embryos, watching for the origin of characters and studying their development in pure bred and hybrid forms.

Very favorable material was found in two species of killifish, *Fundulus heteroclitus* and *F. majalis*. These offered sufficiently wide differences morphologically and physiologically, in eggs, embryos and adults, for experimental study. The most important differences for the study of heredity in early development were differences in size and protoplasmic content of the ova; in time rate of development; in quality, distribution and time of appearance of pigment; in rate and time of establishment of the heart rhythm; in resistances to unfavorable conditions; and the inter-influences of these and other characters.

The following are some of the results obtained:

1. The influence of the sperm of the less rapidly developing species showed a measurable retarding effect upon the egg of the more rapidly developing species in a comparatively short time, usually after about eighteen hours, at which time the blastodisc is beginning to spread out over the yolk. In the reciprocal cross there was a somewhat later, but just as marked, accelerating effect.

2. The influence of maternal and paternal factors was not of constant potency, but alternating waves of parental influence emphasized the fact that heredity is essentially a process involving rhythms of parental influence and constant flux of characters.

3. Certain dominant and hyperdominant characters were shown to be the secondary physiological effects of a primary blending of characters, or, as the necessary result of mere mechanical restrictions, such as size of egg membrane or amount of yolk available.

4. In order to avoid all sorts of complex and contradictory conditions, it was found necessary to equalize the physiological conditions of the parents. Only males and females freshly brought in and at the height of their spawning activities, would give even approximately uniform results in different experiments.

5. It was also found necessary to equalize the environmental conditions of developing embryos. Otherwise highly complex conditions arose that obscured the study of heredity.

6. In view of the fact that external factors, such as physiological condition of parents and environmental conditions of embryos, showed such a marked influence in disturbing the process of heredity, it seems necessary to emphasize the potency of external factors in heredity. Heredity seems to be in essence a developmental process, determined partly by the architecture of the germ-plasm and partly by

external conditions. If either is altered the result is an interference with ideal heredity, which may be defined as identity in process of development between parent and offspring. These two conditioning factors of heredity are of equal potency, since each is efficient only in the presence of the other.

The Rate of Growth of the Egg-yolk in the Chick, and the Significance of White and Yellow Yolk in the Ova of Vertebrates: OSCAR RIDDLE, The University of Chicago.

A method has been found by which the rate of growth of the egg-yolk of the chick may be easily measured. If the fat-stain Sudan III. be fed to laying hens at intervals of one, two or more days, the stain can be found later in the form of concentric red rings in all of the rapidly growing ova. The actual rate of growth varies widely—0 to 2 mm.; but one day of growth normally includes a layer of white yolk and a layer of yellow yolk. It is probable that the layer of white yolk represents the part which is grown during the later hours of the night, and that the yellow yolk is yolk of more rapid growth produced during the remainder of the day.

In the turtle's egg there is a concentric layer of white and another of yellow yolk for each of the four years required (Agassiz) for the complete growth of these ova. Here the yellow yolk undoubtedly corresponds to a part of the egg which is rapidly grown.

A consideration of the formation and arrangement of white and yellow yolk in the ova of the several groups of vertebrates leads to the conclusion that everywhere among these animals white yolk is yolk of relatively slow growth, and that the yellow yolk is yolk of more rapid formation.

For the more intimate explanation of the concentric layers, etc., of white yolk one must take into account two factors which seem to have been overlooked, namely, the reversible action of enzymes which in periods of hibernation or low feeding must tend to analyze and break up the large yolk granules at the periphery of the yolk; at the same time some of the newly formed products of decomposition will leave the peripheral part of the ovum and become distributed between the latter and the surrounding circulating blood according to the requirements of the partition coefficient of each of these substances.

The remarkable arrangement, and apparent elaborate organization of some of the most prominent morphological elements of the larger egg-cells thus receive their physiological explanation.

A Comparison of the Reactions of a Terranean and a Subterranean Species of Isopod: A. M. BANTA, Marietta College.

An investigation of the fauna of Mayfield's cave near Bloomington, Indiana, suggested the desirability of studying the reactions to various stimuli (light, tactile stimuli, etc.) of some cave species in comparison with the reactions to the same stimuli of a near relative living in other situations. The blind cave isopod *Cæcidotea stygia,* and the common asellid, *Asellus communis,* were selected.

It was desired to determine if the increased development of tactile organs in cave animals was accompanied by an increased sensitiveness to tactile stimulation. The experiments proved this conclusively. A second point was to determine the relative sensitiveness of the two animals to light. The cave species proved to be very little sensitive to light compared with its outdoor relative. With directive light the threshold of stimulation was about 2.2 candle-meters with *Asellus* and about 80 candle-meters with *Cæcidotea.* It was also desired to find out, if possible, what were

the factors determining the distribution of the one species within caves, while the nearly related form, though living in the same region, did not take to that habitat. Both species were found to be negatively phototropic ordinarily, and were negative to all intensities to which they responded at all; but *Asellus* after having been in darkness three hours or longer was positive in its response to any intensity to which it responded at all (2.2 candle-meters or greater intensity). This affords an explanation on the basis of reactions to light alone of the occurrence of *Cœcidotea* within caves and *Asellus* outside of caves. *Cœcidotea* responds to such intensities as to enable it to avoid daylight, while *Asellus,* after once having been in darkness for a time, is positive in its response to light, so that, while the former would tend to remain within the darkness of caves, the latter, if it got into a cave, would after a time become positive in its response to light and escape if it happened to come within reach of light from the outside. Another possible factor in determining the cave distribution of the one and not of the other species is the apparently greater discriminative power of the *Cœcidotea* in selecting food. *Asellus* takes with its food a large amount of inorganic matter, while *Cœcidotea,* living as it does where organic matter is relatively very scarce, takes only a small amount of inorganic matter with its food.

The Development of the Thymus in the Pied-billed Grebe: Charles E. Johnson, University of Minnesota. Presented by H. F. Nachtrieb.

The observations here presented are based on a study of the thymus in *Podilymbus podiceps* of approximately the following ages: 4½, 5, 6, 6½, 7, 7½, 8 and 8½ days.

The embryonic thymus in this species of grebe is derived from two separate anlagen the third gill-cleft and the fourth inner and outer gill-pouches. The first anlage arises as a pouch-like outgrowth of the third gill-cleft and the second as a similar outgrowth of the fourth endodermal pouch, to the lateral wall of which elements are added from the fourth ectodermal pouch. Through cell proliferation these pouch-like structures become solid bodies, at the same time becoming separated from the germ layers and finally becoming united, on each side, into a single body, the embryonic thymus. The union or fusion into a single body on each side appears to be largely due to two causes. In the first place, the anlagen become straightened so as to come to lie parallel with the long axis of the neck, which tends to bring them together. In the second place, the medianward shifting of the jugular vein crowds the second anlage over against the first so that the anterior end of the second overlaps the posterior end of the first.

The thymus anlage furnished by the third gill-cleft is larger than that arising from the fourth gill-pouches, and the part played in its formation by the ectoderm is also greater in the former than in the latter.

Four well-defined ectodermal and endodermal gill-pouches are present in embryos about four and one half days old. There is also present a postbranchial body, or structure corresponding to a fifth endodermal pocket, as an evagination of the posterior wall of the fourth inner gill-pouch where this opens into the pharynx. Later on this postbranchial body becomes constricted off and disappears rather rapidly.

On the left side a portion of the third gill-cleft lying between the pharynx and the anlage of the thymus becomes converted into an epithelial body. For a period of about three days this body is continuous

with the pharyngeal wall, on one hand and with the pouch-like anlage of the thymus, on the other. Both connections are then lost and the body disappears before the end of the seventh day. This epithelial body has not been observed on the right side in any of the series studied.

In connection with the second gill-cleft a cell-thickening in every way similar to the thymus anlage of the third gill-cleft is formed simultaneously with the latter, but it begins to degenerate about the sixth day and takes no part in the formation of the thymus.

The Chromosomes in the Gryllidæ: W. J. BAUMGARTNER, University of Kansas.

In a former paper the writer showed that the shape assumed by the chromosomes of *Gryllus domesticus* during the prophase and metaphase of the first spermatocyte division was constant and could be used as a differential characteristic. The spermatocyte has 11 chromosomes.

The examination of nine other species of this family shows a great variation in shape, size and numbers of chromosomes. The highest number is 29 spermatogonic elements and the lowest 13. The accessory in all the species studied exhibits the same peculiarities of shape and behavior as described for *G. domesticus.*

Three species have 23 chromosomes agreeing with the Acrididæ as described by McClung and others.

In several species certain chromosomes can be readily recognized by their shape and size. The tree crickets have 19 spermatogonic chromosomes, of which the accessory and four others are very long. In the prophase the four long ones unite into two enormous rings. If these rings are multiples, *i. e.,* quadruple, as one might easily conclude, then the number of elements in the two species examined is really 23.

Apitlus agitabor has 7 spermatocytic chromosomes. Of these one is the accessory, one is ordinary in size and simple in shape, and the other five are large rings. Should these last prove to be quadruple then the real unreduced number here is also 23.

Nemobius fasciatus has 8 chromosomes in the first spermatocyte, of which 4 are much larger and ring-shaped. Quadrupling these gives a real number of 23. But *Nemobius exigeus* has nine elements, of which also 4 are large rings. Quadrupling these and doubling all but the accessory, we get 25. The number of elements in two other species can not be reduced to 23 by any marked size and shape differences.

Our result shows the three species have 23 chromosomes. Four species can be reduced to 23 by using the "multiple chromosome" idea and three species can not.

The Gryllidæ also have much greater difference in shape and size of chromosome than the Acrididæ. The difference of shape has a marked tendency to be constant.

Was the Hydroid or the Medusa the Original Form of Hydromedusæ? C. C. NUTTING, University of Iowa.

The development of typical forms of Hydromedusæ was briefly described and the alternation of generation discussed.

The elimination of successive terms in the life histories was described and the various methods of reproduction presented, showing the two lines of divergence to the medusa-form, on the one hand, and the hydroid form, on the other; ending in the free medusa without fixed hydranth and the fixed hydranth without medusæ, respectively.

The argument of ontogeny as showing the phylogeny of the group points to the

hydranth as the more primitive form. The homology of hydranth and medusa.

The argument based on radial symmetry points toward the same conclusion.

The Cause of Dominance in Heredity and Experimental Production of Variability in Dominance: W. L. Tower, University of Chicago.

An Important Period in the History of the Sex Cells of Rana pipiens: Bennett M. Allen, University of Wisconsin.

The Experimental Production of Germinal Variations, Methods, Precautions and Theory of their Causation: W. L. Tower, University of Chicago.

Exuviation, Autotomy and Regeneration in Ceratium: C. A. Kofoid, University of California.

The cellulose exoskeleton or theca of the dinoflagellates by virtue of its form resistance, specific surface and specific gravity is an important organ of flotation. Prolongation of the three horns and surface differentiations in the form of lists, fins, ribs and rugosities increase the specific surface and thus facilitate flotation. Walls thickened by age or by compensatory regeneration cut off access of light to the chloroplasts and also increase the specific gravity. Low temperatures increase the molecular friction of water and thus increase its buoyant properties. Changes in vertical location of these pelagic protozoa or modifications in the temperature of the circumambient medium thus demand an adjustment of this organ of flotation to the changed conditions of environment.

In many dinoflagellates the exoskeleton is shed periodically *in toto* by ecdysis either with or without schizogony. In *Ceratium,* at least in the marine species, ecdysis is unknown. In schizogony of *Ceratium* the theca is parted diagonally along definite suture lines between the plates and each daughter cell regenerates the missing half, maintaining the ancestral facies throughout by compensatory regeneration. Long-continued schizogony gives rise to individuals of senile aspect with heavy rugose exoskeleton. Examination of San Diego plankton has brought to light evidence of the fact that heavily armored *Ceratium* in warm surface waters drop off this exoskeleton by exuviation, piecemeal, plate by plate, and regenerate a new wall of more delicate texture.

In deeper levels or in plankton at San Diego of semitropical facies autotomy of the horns is frequent. This autotomy may occur at any level of the horns from the tip to the base. It occurs in both antapical horns coincidently and may also appear in the median apical horn. It is regulatory in character, for the specific type of balanced relationship of the antapicals is approximately preserved. Autotomy is an adaptation to flotation at deeper levels or in higher latitudes.

Regeneration of the horns after autotomy and also renewed growth of the horns without autotomy result in an increase in specific surface and are adaptations to flotation in higher levels or lower latitudes. This regeneration is usually terminal, but is sometimes basal in location on the horns. It is also regulatory in character, preserving the balanced relation of symmetry or asymmetry of the horns which is characteristic of the species.

Muscle Attachment to the Body Wall in the Nymphs of Anax: W. A. Riley, Cornell University.

The alary muscles of the nymph of this dragon-fly are exceptionally favorable for the study of the relation of the muscles to the body wall. The hypodermal cells at the point of attachment of the muscles are very much elongated (about $50\,\mu \times 5\,\mu$), and in specimens fixed in alcohol and

stained in Delafield's hematoxylin there is every indication that the attachment is through the intermediary of these cells. However, in thin sections (2 μ–3 μ) fixed in Flemming's fluid and stained in iron hematoxylin it is seen that the muscle fibrillæ pass through the cells and thus attach directly to the cuticle. Study of developing muscle indicates that, in Snethlage reports for *Artemia*, the cells are epithelial muscle cells which give rise to the chitin, on the one hand, and to the muscle as well.

The Skeletal Parts of the Sand-dollar: EMILY RAY GREGORY, Wells College.

The test of the sand-dollar follows the structure typical for echinoderms, but has some interesting modifications. The apical region is occupied by a single plate which functions as the madreporite. The minute pores are irregularly arranged and increase in number as the animal grows. There are genital pores at the junction of the central plate and the first pairs of interradials 1–4, but the pore is wanting in the interradial area 5. Ocular pores occur between the central plate and the first pairs of ambulacral plates. The anus is found on the ambitus between the rows of interradial area 5. Oral plates are wanting and there are only minute calcareous granules in the membranous peristome. The ring of plates nearest the mouth consists of ten (paired) ambulacral plates, and five, therefore unpaired, interambulacrals. Some authors appear to refer to this now as the peristome. The coronal portion of the test with its peculiar petal areas is familiar. The line of the ambitus does not correspond to the sutures between the plates. The perignathic girdle is reduced to an inconspicuous ridge, but on the unpaired interradials there are wedge-shaped apophyses to support the lantern. The number of plates on the oral surface is established by the time the test is 7 mm. in diameter; after this these plates increase in size but not in number. The number of plates on the aboral surface increases until the diameter of the test is 46 mm. After that a few more plates may be added to the petal area as the last interambulacrals increase in size. Increase in the number of plates occurs only at the edge of the central plate and is, of course, greatest in the ambulacral area. There may be seven or even nine plates in the petal to one interradial. All the plates of the ambulacral system are primary; no such secondary and tertiary plates are found here as are seen in *Echinus* (Chadwick). The pores in the petal area are all between the plates. Elsewhere they may pass through the plates. The unpaired pores increase in number from the petal to the edge in wedge-shaped areas which meet, and there is a dense ring of them about the ambitus where there may be three or four rows of pores through a single plate.

The inner surface of the skeleton shows remarkable structures. The distal half or third is almost covered with pillars and ridges which grow from both surfaces and fuse, leaving small irregular spaces between. The spines in cross-section are star-shaped, with four to thirteen points. Longitudinally they show a fenestrated structure. Six forms are to be distinguished in different areas.

A Study of Colorado Entomostraca: GIDEON S. DODDS, University of Colorado.

Up to 1902 but 10 species of *Entomostraca* were listed from Colorado. That year Beardsley published a list which included 24 species new to the state. His collections were from the plains region. In 1904 Professor Henry B. Ward added 8 species from alpine lakes in the Pikes Peak region, and in 1907 Chancey Juday listed 10 more from Twin Lakes. Three others

are listed by Marsh in the same year. These 55 species are, so far as the writer can learn, all that are known for the state.

Collections have been made by the author from a number of lakes on the eastern slope of the Rocky Mountains. These lakes comprise a pretty complete series, from plains lakes at an altitude of about 5,000 feet, to lakes at 11,500 feet which are never free from snow and ice. The alpine *Entomostraca* and the factors governing their distribution are being studied. Collections show that there is a rich Entomostracan fauna, except in the very highest lakes, where all animal life is scarce. The writer has thus far determined 14 species, three of which are new to the state.

The Relation between Habitat and the Taxonomic Characters of Gryllus: Frank E. Lutz, Carnegie Station for Experimental Evolution, Cold Spring Harbor, N. Y.

Size of taxonomic characters is a function of the factors of the environment.

Sociology applied to Pigeons: Wallace Craig, State Normal School, Valley City, North Dakota.

Zoology and psychology have long labored to explain the elaborate singing and cooing, dancing and strutting, and other such performances of birds. The results have been most unsatisfactory—zoology and psychology are not sufficient to explain such behavior, for it needs sociologic treatment.

An intimate acquaintance with pigeons impresses one with the fact that their cooing and strutting performances are a kind of ceremony. Just as the primitive man must perform a certain ceremony upon every important occasion in his life, so the pigeon must give a certain call or coo, and must go through a bowing or strutting performance upon all important occasions; as, when he awakes in the morning, when he goes to roost at night, when he joins the flock, when he meets another male to fight, when he meets a female to court, etc.

The utility of these pigeon performances is the same as that of ceremony in primitive man—social control. There is a prevalent notion that animals which form societies, especially the ants, bees and wasps, are so mechanically bound together as to be free from that conflict between individuality and sociality which is so marked in human life. This notion is erroneous: it is probably erroneous even with regard to ants, bees and wasps; it is certainly erroneous if applied to pigeons; the pigeon is a true free individual, hence social ends among pigeons can be secured only by some means of social control. The social life of pigeons is chiefly family life of a highly complex and specialized nature: the numerous details of this family life are regulated by social control; the actions of the different individuals in the family are connected and socialized through control by ceremonial observances.

Occurrence of the Cysticercus of Tænia solium in Sheep: B. H. Ransom, U. S. Department of Agriculture.

A number of cases of the occurrence of cysticerci in the muscles of sheep have been reported by various authors. In most cases the data given are not sufficient to show definitely whether the cysticerci in question belong to *Tænia solium,* the armed tapeworm of man, as some authors have believed, or whether they belong to *Tænia hydatigena,* the marginate tapeworm of the dog, as maintained by other authors. Bongert (1899), however, has described a cysticercus found in the muscles of a sheep, which is evidently the cysticercus of *Tænia solium,* and that the sheep may act as the intermediate host of this tapeworm of man seems therefore to be pretty well established.

Dr. L. E. Day, in charge of the branch pathological laboratory of the Bureau of Animal Industry at Chicago, recently sent into the Zoological Laboratory of this bureau specimens of the muscles of a sheep extensively infested with small cysticerci. These cysticerci when removed from the capsule surrounding them measure 2 to 3 mm. in diameter and are slightly oval in shape. The head process projects into the bladder from one side, as is the case in the cysticercus of *Tænia solium*. In the cysticercus of *Tænia hydatigena* the head process is invaginated from one end of the bladder instead of from the side. Possibly, however, the position of the head depends upon the location of the parasite rather than upon specific peculiarities. Accordingly, it might happen that the head process would develop from the side of the cysticercus of *Tænia hydatigena* instead of the end if the parasite were located in muscle tissue, and the fact that in the mutton cysticerci found by Dr. Day the position of the head process is different from that in the cysticerci of *Tænia hydatigena* when located in relation with the serous cavities of the host, the usual location, can not be considered absolute proof that the mutton cysticerci in question do not belong to *Tænia hydatigena*. The hooks of these cysticerci number from 24 to 32 in different specimens. The large hooks measure 135 to 160 μ in length, and the small hooks 100 to 120 μ. The roots of the hooks are only slightly developed, and the hooks, therefore, do not present all of the characters to be found in fully grown hooks, so that on the basis of the hooks alone it would be difficult to determine whether these cysticerci belong to *Tænia solium* or to *Tænia hydatigena*. Since, however, they possess a prominent characteristic of *Tænia solium* which is not shared by *Tænia hydatigena*, that is, the outer surface of the bladder is marked with numerous small tubercle-like projections, and since also, in other particulars of structure as well as in location (in the muscles) they agree more closely with the former than with the latter species, they have been identified as *Tænia solium*.

Further Results of Heterotransplantations of Blood-vessels: C. C. GUTHRIE, Washington University.

Continuity of divided carotid arteries in dogs was reestablished by interposing segments of blood-vessels from cat and rabbit. Good function was observed after more than eight months.

On the Ovary and Ova of the Cuban Cavefishes: HENRY H. LANE, University of Oklahoma.

The viviparous blind-fishes (*Lucifuga* and *Stygicola*, family Brotulidæ) living in the subterranean streams of Cuba have a Y-shaped ovary which consists of a mass of stroma containing numerous sinuses filled with lymph and adipose tissue, and the whole covered with an epithelium continuous with that lining the surrounding ovisac. This epithelium is quite unique in that it frequently contains numerous blood-capillaries. The ova arise in "nests" or masses of several hundred each, deep within the substance of the stroma and in the adult ovaries have at that time an average diameter of about ten micra. Only one ovum from such a nest usually develops to maturity, the other ova of the nest undergoing a rapid degeneration and being ultimately absorbed into the substance of the growing ovum. In many instances whole nests fail to mature a single ovum, in which case all the ova of such nests undergo a slow, pigmented degeneration *in situ*. This destruction of so many ova at an early stage is an adaptation to the viviparous habit of these fishes. The whole ovary as just described is enclosed within a Y-shaped ovisac which is continued to the urogenital pore as the oviduct. The young

fishes, which are but few in number, only two to ten in any case as yet observed, are not developed in separate sacs, but lie within the lumen of the ovisac, gradually compressing the ovarian stroma as they develop. They attain a length of 20 to 25 millimeters before birth, while the adults may be as much as 100 millimeters long. Viviparity is apparently a comparatively recent acquirement of these fishes, though probably attained before they left the deep-sea for the fresh-water cave streams.

Notes on Diplosis sorghicola Coq.: Carleton R. Ball, U. S. Department of Agriculture.

The frequent failure of sorghums to produce seeds in our southern states has long been noted. Many theories regarding the cause have been advanced: fungi, insects and unfavorable meteorological conditions, such as excessive precipitation, high humidity. Severe drouth or hot winds are the causal agencies most commonly assigned. Among the growers this trouble is known as "blast" and is usually held to be caused by excessive rainfall and the consequent washing away of pollen during the blooming period. Experiments made during the past season proved conclusively that the injury results from the attacks of a small fly, which has been identified as *Diplosis sorghicola* Coq., for which the name sorghum midge is here proposed. The eggs are laid within the spikelet and the larva absorbs the juices of the ovary through its body walls, causing the death of the ovary and sterility of the infested heads. The insect is prolific; the life cycle is short; and the crop is totally destroyed in badly infested areas. Two parasites are known. Relief may also be found through breeding immune varieties.

Mechanics of Orientation in Lower Organisms: S. O. Mast, Johns Hopkins University.

Orientation in lower organisms stimulated by light may be classified as direct and indirect. In direct orientation the organism turns directly toward or away from the source of stimulation, *e. g., Volvox, Arenicola* larvæ, etc.

In indirect orientation the organism makes preliminary random movements, which bear no definite relation to the apparent point of stimulation, until it reaches a position in which the stimulation is reduced to a minimum. This position it retains in moving forward and thus becomes oriented.

The random movements resulting in orientation may be restricted to motion toward a structurally defined side, as in *Euglena, Stentor,* etc.; or they may not be thus restricted, as in some of the worms.

A detailed study of the structure and light reactions of *Euglena,* which orients indirectly, and *Volvox* and *Arenicola* larvæ which orient directly, shows that the reactions of these three forms, apparently so different, are fundamentally the same. There does, however, not appear to be any definite relation between the reactions of organisms which orient by means of unrestricted preliminary random movements and the reactions of those in which the random movements are restricted to motion toward a structurally defined surface.

No theory of reaction yet formulated covers all cases. The theory of Sachs, formulated for light reactions in plants and accepted by Loeb, who applied it to animals, is not in accord with the observed reactions in any of the organisms studied.

On some Isopods of the Family Dajidæ from the Northwest Pacific Ocean, with Descriptions of a New Species and a New Genus: Harriet Richardson, Smithsonian Institution.

During the cruise of the U. S. Bureau of Fisheries Steamer *Albatross* to the

Northwest Pacific Ocean, some new Dajidæ were collected, one being the type of a new genus, *Arthrophryxus,* and the other the type of a new species of *Holophryxus, H. giardi.* An immature stage of *Holophryxus giardi* was also obtained and is of interest in being a stage not heretofore recorded in the development of the female from the cryptoniscian larva to the adult form. Both of these parasites are attached to the dorsal side of the carapace of the host with the head directed posteriorly. The male *Holophryxus alascensis* Richardson is also described for the first time from a specimen obtained at Monterey Bay.

Leidya distorta (Leidy) Found on a New Host: HARRIET RICHARDSON, Smithsonian Institution.

Specimens of *Leidya distorta* (Leidy) found in the branchial cavity of *Pachygrapsus transversus* Gibbes, from the Bermudas, were recently sent me by Professor A. E. Verrill. This species has been recorded as found in the branchial cavity of *Uca pugilator.* The fact that this parasite has been found on a new host gives evidence that this genus and species is not confined to one genus and species of host. As no descriptions or figures of this form have been given since those published by Leidy, the parasite is again described and figured, as well as the young female, which is described and figured for the first time.

The following demonstrations were exhibited:

L. B. Walton: (1) The ideal dissecting tray; (2) early stages of *Eurypauropus spinosus* Ryder; (3) museum cataloguing; accession and department catalogue cards.

Henry F. Nachtrieb: (1) Early stages in the development of the thymus of the pied-billed grebe—reconstruction of one stage; (2) the sensory ridges of the lateral line and the primitive pores of *Polyodon spathula.*

R. M. Strong: A litter of short-tailed and tailless puppies.

Thomas G. Lee: Early stages in the development of *Dipodomys* and other rodents.

F. R. Lillie: Karyokinetic figures of centrifuged eggs.

S. O. Mast: An electric thermo-regulator.

Charles Brookover: Ganglion cells on Pinkus's nerve of *Amia* and *Lepidosteus.*

R. S. Sheldon: Medullated nerve fibers in the olfactory mucous membrane of fishes.

W. L. Tower: (1) Demonstration case to illustrate the evolution of the *lineata* group of the genus *Leptinotarsa,* showing forms that have been produced in experiment and sports occurring in nature; (2) demonstration case to illustrate the results obtained in the production of sports experimentally—arranged to show the results produced in the stimulated germ-cells and the results from those not stimulated in the case of the same parent; (3) demonstration case to show the results obtained in the transplantation of *Leptinotarsas* from one habitat into another and the proof that they are different in the new habitat as demonstrated by the behavior of the modified and unmodified form when crossed with a third species; (4) demonstration cases to illustrate results obtained in the study of variability of dominance in crossing.

C. R. Bardeen: Abnormal toad and frog larvæ from eggs fertilized by spermatozoa exposed to the Roentgen rays.

W. J. Baumgartner: A cheap sharp microtome knife.

Section F of the American Association for the Advancement of Science was organized at the Chicago meeting with the following officers:

Vice-president and Chairman of the Section—E. B. Wilson, Columbia University.

Secretary—C. Judson Herrick, University of Chicago.

Member of the Council—C. H. Eigenmann, Indiana University.

Member of the General Committee—G. E. Coghill, Denison University.

Sectional Committee—E. B. Wilson, vice-president, 1908; E. G. Conklin, vice-president, 1907; C. Judson Herrick, secretary; Frank Smith, one year; W. E. Ritter, two years; A. W. Bleile, three years; A. L. Treadwell, four years; C. C. Nutting, five years.

At the business session of the Central Branch of Zoologists the following officers were elected:

President—E. A. Birge, University of Wisconsin.

Vice-president—M. F. Guyer, University of Cincinnati.

Secretary-Treasurer—H. H. Newman, University of Michigan.

Member of the Executive Committee for Three Years—C. M. Child, University of Chicago.

The following were elected to membership in the Central Branch: Oscar Riddle, V. E. Shelford, W. S. Miller, A. W. Meyer, James A. Nelson, C. J. Herrick.

THOMAS G. LEE,
Secretary

UNIVERSITY OF MINNESOTA

SCIENTIFIC BOOKS

A First Course in the Differential and Integral Calculus. By WILLIAM F. OSGOOD, Professor of Mathematics in Harvard University. Pp. xv + 423. New York, The Macmillan Company. 1907.

First Course in Calculus. By E. J. TOWNSEND, Professor of Mathematics in the University of Illinois, and G. A. GOODENOUGH, Associate Professor of Mechanical Engineering in the University of Illinois. Pp. x + 466. New York, Henry Holt and Company. 1908.

A Course in Mathematics for Students of Engineering and Applied Science. By FREDERICK S. WOODS and FREDERICK H. BAILEY, Professors of Mathematics in the Massachusetts Institute of Technology. Vol. I. Pp. xii + 385. Boston, Ginn and Company. 1907.

Graphic Algebra. By ARTHUR SCHULTZE, Assistant Professor of Mathematics, New York University, and Head of the Department of Mathematics, High School of Commerce, New York. Pp. viii + 93. New York, The Macmillan Company. 1908.

A Treatise on the Integral Calculus founded on the Method of Rates. By WILLIAM WOOLSEY JOHNSON, Professor of Mathematics at the United States Naval Academy, Annapolis, Maryland. Pp. v + 440. New York, John Wiley and Sons. 1907.

People who have to do with mathematics fall temperamentally into three classes. There are the theorists. These are interested in doctrines as doctrines. They find their joy in the construction and the understanding of them, and have but little personal interest in applications and utilities, or none at all. The theorist is a lover of logic, of the abstract and the recondite, of pure creations of the intellect. For him a mathematical doctrine is a work of art, of art that is supersensuous, and a theory is valuable in proportion as it is beautiful. In sharpest contrast with the theorists stand the practicians. These despise theory as such, sometimes denying the fact, sometimes admitting it and occasionally avowing it even boastfully. They look upon mathematics as a mere tool, as a spade or a wheelbarrow. The practician is not a man of science, strictly speaking, and he is not an artist. He is an artisan, not an artisan of high type, indeed, nor yet entirely useless. He is allied to the theorist very much as the splitter of rails or the painter of a barn is allied to a sculptor, a creative musician or a master of color and design. The theorist and the practician are organically antagonistic in temperament. The former comprehends the latter as the greater includes the less. The theorist contemns mere practise and avoids it, but he does so deliberately from a knowledge of values and relative worths. The practician hates theory and avoids it, but he does so from necessity, by the "virtue of impotence." The differences between them, be-

ing organic and fundamental, can be neither composed nor annulled. Fortunately for an age that glories in possessing and is bent on advancing a material civilization that theorists never would and that practicians never could produce, there is a third class among those who have to do with mathematics, a class composed of two groups of men: a group interested primarily in theory, in mathematics as a science, yet having a strong secondary interest in applications, in practise, in mathematics as a tool; and another group chiefly interested in practise that involves applications of mathematics, but having at the same time a potent secondary interest in the subject as a science, as a body of consistencies, an ensemble of coherent doctrines. The latter group, the engineers, tend to keep mathematics sane, serviceable, attached to reality, adapted to the needs of the surveyor, the miner, the excavator, the bridge-builder, and the rest; the former group, comprising most of the professional mathematicians and the teachers of mathematics, serve to save the science from degenerating into a mere drudge, and by extending its structures far above the conscious needs of man, make it an everlasting monument to his dignity and an honor to his spirit. Thus the interests of these two groups, unlike those of the theorist and the practician, intersect; and as there is the need of better cooperation between the groups, there is also, by virtue of their community of temperament, the possibility of securing it. The engineer says to the teacher of mathematics: "Make your science more serviceable, lay bare its instrumental significance, teach us how to use it." The teacher replies: "Your demand is just and reasonable, but you should understand that the application of a difficult doctrine to a difficult concrete problem presupposes an understanding of the doctrine as a doctrine and that such understanding requires native ability and prolonged study." As a reasonable man, the engineer must admit that the teacher, too, is right. What, then, is to be done? The answer is: compromise.

How to effect the compromise to the best advantage of all the interests involved—the integrity of the science itself, the insistent claims of the technologist, the indubitable rights of those who pursue the study of mathematics solely as a discipline and especially of those rarer spirits who hope to make it the object of a life's devotion—that is the question that presses upon the teachers of mathematics in our day and that, owing to the familiar rapid multiplication of technological schools, presses especially hard upon teachers of the calculus. In Professor Osgood's book culminate the efforts of nearly a generation of mathematicians to produce a beginner's calculus that shall be both rigorous and understandable, theoretic enough to be scientific and sufficiently practical for the student of engineering, not too spiritless for those whose aim is liberality of culture and yet adequate as a preparation for the intending student of still higher disciplines. For directness and simplicity of presentation, clearness and correctness of statement, judicious accentuation and ordering of topics, and for the happy mingling of the concrete and particular with the abstract and general, this work attains a level of excellence not likely to be soon surpassed. The author estimates that the time required for covering the matter of the book corresponds roughly to a five-hour course throughout one year. The estimate is based, however, upon the lecture method of presentation. In the case of lectures adapted to undergraduates, this method, whatever be its compensatory advantages, is undoubtedly less rapid than that of assigning definite lessons and requiring recitations upon them. By employing the latter method of instruction and by omitting the chapter of about forty pages devoted to mechanics—an omission entirely practicable in a considerable number of institutions that provide a separate course in elementary mechanics to follow the calculus—it would seem to be possible to cover the remainder of the matter fairly well in a three-hour year course or even in a five-hour half-year course. Indeed, if one make the mentioned omission, the remainder of the book, owing to wider margins and other physical features, only appears to contain more reading matter than such a book, for example, as Osborne's revised "Calculus," and this last, as experience has shown, can be

mastered in a three-hour course of one year. In view of the high excellence of the book one hesitates to note so minor an infelicity as the recurring phrase, tangent *in* a point; or to query why the notion of limit is not defined instead of being presupposed; or to question the scientific or the didactic value of the cautionary note (p. 5), for while it is true that two coincident points of a curve do not determine a secant, is it not also true that, if P be a point of a curve admitting a tangent T at P and if P' be a second point of the curve, the secant PP', if P' move along the curve into coincidence with P, at the same time rotates about P into the definite position of coincidence with T? The tangent T is not, indeed, then determined by the mere coincidence of P and P', but by that *coincidence regarded as having resulted from P' moving along the curve.*

Professors Townsend and Goodenough's "Course" is a notable contribution to the text-book literature of the calculus. It is too large by a hundred pages to admit of the satisfactory presentation of the whole of it in the time usually allotted to the subject even in the best schools. The thickness of the volume is partly due, however, to the presence of a chapter dealing with ordinary differential equations, an excellent table of integrals, a table of answers, and a good index that renders the book a convenient work of reference. The method of limits is employed exclusively. The notion of integration is introduced at an early stage, and topics are in general arranged in the order of increasing difficulty, such topics as infinite series, expansion of functions, singularities of plane curves, envelopes and the like being reserved for treatment when the reader shall have had time to confirm his grasp of fundamentals. It is especially noteworthy that the book is a joint product of a professional mathematician, who is chiefly responsible for the theory, and a professional teacher of mechanical engineering, who is largely responsible for the practical aspects of the work. Indeed, the applications of the subject are about equally distributed between geometry and mechanics, a fact that should be of interest to the student of engineering, though the book is by no means written for him alone.

Professors Woods and Bailey's book is the first volume of a work in course of preparation which is designed to present together—that is, in a single course—so much of algebra, analytical geometry, calculus and differential equations as is usually required of engineering students in the first two years of their professional study. The attempt represents a wholesome reaction against the long-prevailing practise of presenting these subjects in as many separate courses, and of thus incidentally giving the student the impression that the several doctrines are essentially insulated and independent, instead of being, as in fact they are, but different parts of one complicate instrument or different organs of a single body of doctrine. The experiment sufficiently commends itself *a priori* to deserve a fair trial, though this will not be easy in view of the readjustment of programs and schedules necessarily involved. The danger of the reaction lies, of course, in the opposite extreme, namely, of so presenting a group of interpenetrating disciplines that they shall produce the effect of a mere *mélange*.

Professor Schultze's "Graphic Algebra" is an excellent introduction to the plotting of equations and therewith to the graphical representation of functional dependence in general. The method is illustrated in connection with equations of the first four degrees in two variables. An appendix extends the method to other than equational relationships, and furnishes for practise some tables of data drawn from a considerable variety of fields. The book is timely and should be interesting to many, for this is indeed the age of coordinates and graphical depiction, the method long familiar in analytical geometry having proved its availability in almost every field of study, including even the critical study of biblical literature.

Professor Johnson's "Integral Calculus" treats more fully than his earlier one on the same subject of reduction formulæ and of multiple integrals. It contains, besides, new chapters dealing with mean values, probability, definite integrals (including the Eulerian),

Fourier's series and other topics, including functions of the complex variable. There are numerous references to the author's "Differential Calculus" which is essential to the reading of the present work. Both treatises are based on the method of rates and both enjoy both the advantages and the disadvantages that attend adherence to that method. The work will serve, too, as a welcome auxiliary to Professor Johnson's well known and widely used "Differential Equations."

C. J. KEYSER

COLUMBIA UNIVERSITY

SCIENTIFIC JOURNALS AND ARTICLES

The American Naturalist for April is devoted to a symposium on "Aspects of the Species Question," being the papers presented at the January meeting of the Botanical Society of America, by Charles E. Bessey and others. The aspects are taxonomic, physiological and ecological and the views of the various authors are naturally more or less colored by the nature of their work. Many will thank C. L. Bristol for his quotation showing the origin of the "Otter Sheep," as information of this kind is most difficult to lay hands on. One may know the general facts and yet be unable to give a definite reference to them.

BIBLIOGRAPHIES are always welcome, and the "Index to Hull (England) Museum Publications, Nos. 1–47," will be of much service in facilitating reference to the many objects in the Hull Museum described during the past six years.

The Museums Journal of Great Britain has a description, by E. Howarth, of "The School Museum System of Sheffield" with details of the circulating collections, stereoscopic views and lantern slides for loan to public schools. The cost of the individual "cabinets" in these collections was stated to be from $25 to $75 each, which must be regarded as a pretty liberal sum.

THE *Reports relating to Alaskan Seal Fisheries,* recently issued by the Department of Commerce and Labor, contain much interesting information in regard to the seals of the Pribilofs, and the Arctic fox. The seal herd has steadily decreased, owing to pelagic sealing and the total number in 1907 was only about 172,000 as against 400,000 in 1897. The greatest destruction is now wrought by the Japanese, who are not bound by any agreement, seal up to the three-mile limit (sometimes within it) and use shot-guns which cause great loss and waste. Owing to the adoption of certain restrictions proposed by the government agents the proportion of active young bulls has increased.

THE *First Biennial Report* of the Louisiana State Museum, covering the period December 10, 1906 to April 1, 1908, has just been issued. It gives a brief account of the origin of the museum and includes a general catalogue of the exhibits of the various departments. These include a fair representation of the fauna of the state, a considerable proportion of commercial products and some extremely valuable and interesting historical material. It is to be hoped that this museum may receive substantial support from the state.

SOCIETIES AND ACADEMIES

THE GEOLOGICAL SOCIETY OF WASHINGTON

AT the 205th meeting of the society, on April 22, 1908, specimens of "coal bombs" from Walsenburg, Colo.; Las Cerillos, N. M., and the Pennsylvania anthracites were exhibited by David White, who remarked that these nodule-like masses from the midst of coal beds often show a combination of slickensiding and concentricity of structure suggesting tension in one plane rather than pressure in all directions. Such nodules or bombs, found in coals of varying age and kind, are probably more frequent than would be supposed from their rare mention in the literature.

Regular Program

Mineral Deposits of the Cerbat Range and Black Mountains, Mojave County, Arizona: Mr. F. C. SCHRADER.

The Cerbat Range and Black Mountains are two desert ranges situated about twelve miles apart in the northwestern part of Arizona, southeast of the Big Bend of the Colo-

rado River and between the river and the Colorado Plateau. They represent the southward continuation of the Virgin and Muddy Mountains of the Great Basin on the north. The principal distributing point for the mining districts is Kingman, situated on the main line of the Atchison, Topeka and Santa Fe Railway.

The deposits, concerning which little has hitherto been known, occur principally in two regions: One in the Cerbat Mountains, where the deposits are distributed over an area that extends from about nine miles north of Kingman to twenty miles north, embraces the Chloride, Mineral Park, Stockton Hill and Cerbat districts. The other region is in the southern part of the Black Mountains, where it embraces the well-known Gold Road and Vivian districts, situated about twenty-four miles southwest of Kingman. Both regions contain numerous mines, many of which have produced from about $1,000,000 to $3,000,000 each; the production of the Gold Road mine being about $1,000,000 in the two years 1905 and 1906.

The deposits are of two very distinct types. The first, which is confined chiefly to the Cerbat Range, consists of quartz fissure veins, usually in the pre-Cambrian complex of granitoid-gneiss-schist rocks. The veins usually are not deeply oxidized. They contain the sulphides, pyrite, galena, zinc blende and arseno-pyrite, which yield silver chiefly, but with minor amounts of gold.

The second group comprises the deposits of the Black Mountains. They differ markedly from those of the Cerbat Range, just described, in several important respects. First, they occur chiefly in Tertiary volcanic rocks, principally andesite, and are younger than the Cerbat veins. Second, the veins seem to have originally contained a calcite gangue, which is still present in many of them. In the most valuable deposits, however, a mineralogical change has taken place, by which the calcite has been replaced by quartz and adularia. Third, the values are almost exclusively gold. Fourth, the oxidation extends to the depth of 600 or 700 feet, and, as a rule, no sulphides or base metals are found.

The deposits of both types are believed to owe their origin to the circulation of mineralized, aqueous solutions probably at high temperatures through the fissures in which the values are now found.

Recent Work on the Illinois Coal Field: Mr. Frank W. De Wolf.

The Illinois Coal Field covers an area exceeding 36,000 square miles and supports over four hundred commercial mines scattered through fifty counties. The preliminary estimates place the production for 1907 in excess of forty-nine million tons, and thus indicate an increase during the year of over twenty per cent.

While the general features of the stratigraphy and structure have been presented in earlier reports, the problem remains to divide the stratigraphic column into appropriate formations and to carry the correlation of the sixteen or more coals through the state. This work is going forward by cooperative investigations of the State and U. S. Geological Surveys.

Certain chemical problems have been investigated, also; one refers to variations in the quality of coal seams from place to place; another, to the relation between analyses of mine samples and commercial samples, with especial regard to the deterioration of coal during storage. Another consideration of vital importance refers to the selection of some "pure coal" unit which may serve as a basis for comparing samples of varying composition.

Detailed reports are finished for parts of Saline, Gallatin and Williamson Counties. The explored rocks include some fifteen hundred feet of carboniferous sediments, and these include two widely persistent coals of approximately five feet in thickness and of excellent quality, besides numerous local beds. The dip of the rocks is essentially northward toward the center of the basin, but is interrupted locally by dome-like features which suggest block-faulting on a small scale. The structural relief, as shown, is four hundred and twenty-five feet. In some cases the coals are cut by igneous dikes which produce nat-

ural coke along the contacts and which contain occasional crystals of sphalerite, thus suggesting relationship to near-by counties which produce lead and zinc.

Panama Stratigraphy: Mr. ERNEST HOWE.

Following andesitic breccias that are supposed to be of early Eocene age, sedimentary rocks belonging to three epochs have been recognized in the section exposed on the Isthmus of Panama. The oldest, the Bohio formation, has conglomerates associated with volcanic breccias near the base, but consists for the most part of fine calcareous sandstones and shales. An abundant fauna contains species characteristic of the Claiborne Eocene and some common to the Upper Tejon. Separated from this by an unconformity are the Peña Blanca marls rich in foraminifera that, from the characteristic species *Orbitoides fortisi,* Dr. Dall considers of Lower Oligocene age corresponding to the Vicksburg. The youngest sedimentary rocks are those of the Monkey Hill formation consisting of fine calcareous and argillaceous sandstones and marls. From abundant fossils contained in these beds they are regarded as equivalent to the Chipola Oligocene. Of these three formations the oldest only, represented by the Culebra beds, has been observed on the Pacific side of the isthmus.

Eruptions of rhyolitic rocks, both massive and fragmental, occurred at some time between the close of the Bohio epoch and the beginning of the Monkey Hill, while all the rocks in the central and southern portions of the isthmus were invaded in the Miocene by pyroxene-andesites and basalt.

RALPH ARNOLD,
Secretary

DISCUSSION AND CORRESPONDENCE

THE CHAIR OF PHILOSOPHY AT THE UNIVERSITY OF CINCINNATI

TO THE EDITOR OF SCIENCE: I beg permission to make a statement relative to my deposition from the University of Cincinnati.

First, I should like to say that the three reasons assigned for declaring my chair vacant are either inadequate grounds for such action or are false in fact. Furthermore they are not the reasons stated in private by the president.

The three grounds assigned were (1) The suppression of the real reasons for my leaving Vassar when I applied for the position at Cincinnati. I agree with the president on this point that this was not fair to him and so informed him before his request for my resignation. But is this an adequate basis for deposing an officer whose work is admittedly satisfactory?

The second ground was that I held views destructive of society which affected my teaching and my life. The testimony of my students both here and at Vassar College refutes the charge that my views on certain ethical topics had entered the classroom. The testimony of my wife and of those who know me must intimately is sufficient reply to the charge of baneful effects of my alleged sinful views upon my life and character. The objection that now, at least, I have taught my views by their publication in the newspapers is certainly met by replying that a man has a right to state his views on any subject in this age and country as long as he does it in a dignified and decent way. And since I was asked to resign on account of my views (which fact is significantly omitted from the formal statement issued by the president) I maintain that I had a right to vindicate myself before the public by stating the views for which I was to be ejected. If it be objected that I did not choose the proper place and manner of publicity in stating my views, it is replied that the only statements authorized by me were given to the Cincinnati *Times-Star* with the understanding that they were to be printed just as I wrote them or not at all. They were so printed in that paper. Additions and embellishments by reporters unhappily have been taken as expressing my views, instead of my own carefully prepared statement of them.

The third ground assigned by the president for my dismissal, that I threatened him, did not exist.

I made this stand here at Cincinnati in the hope that I might be dealt with on the

basis of the merits of the case. The three grounds assigned evade the real issue of my views which was privately stated by the president to be the basis of his action. And this real issue, which is not frankly stated, but set aside by the interposition of an unjustifiable personal attack, is a violation of the principle of *Lehrfreiheit*.

H. Heath Bawden
University of Cincinnati,
May 31, 1908

SPECIAL ARTICLES

A METHOD OF SENDING PURE CULTURES OF FUNGI

For several years the writer has had occasion to receive cultures of moulds from different parts of this country and from abroad and has learned to expect a large percentage of contaminations even when the cultures are pure when shipped. The usual method is to send a pure culture of the mould in a fresh slant tube of nutrient which has been hardened with either gelatin or agar. During transit the nutrient generally becomes shaken up against the cotton plug and there results an infection of bacteria or of moulds like *Penicillium* and *Aspergillus*, the spores of which are usually present on the outside of the cotton plugs but which germinate and grow down into the tubes when the plugs are wet or the surrounding air is rendered moist by rubber caps or even by paper wrappings which more or less completely seal the tubes. Recently the writer received a shipment of a considerable number of tubes from Utrecht, Holland, from the fungus collection of the Association Internationale des Botanistes. They were apparently fresh cultures and a very large proportion were thus irredeemable from contamination with weed fungi. It seems not undesirable, therefore, to describe in some detail a method of shipping cultures which experience has shown to be free from the objectionable features already mentioned, although it is a method which might naturally occur to any one having spores to send.

If cultures are to be sent in test-tubes it is advisable to avoid gelatin and to use rather stiffer agar than usual, which should be allowed to dry out and thus fasten itself against the sides of the tubes before packing. For stock cultures, which are to be kept a year or so, the writer has successfully used as much as 30 and even 35 grams of agar to the liter, and agar of this degree of hardness might be used for shipping. While with proper precautions pure cultures may be sent in test-tubes yet the possibility of breakage or of infection already pointed out, as well as the possible inconvenience of custom-house inspection when packages are received from foreign correspondents, are objections to this method.

These disadvantages have led the writer to use small paper envelopes such as are made by druggists in putting up powders or by botanists in preserving fungi in exsiccati. A mass of the fungus filaments containing spores are taken with a sterilized instrument from a pure culture of the species desired, together with some of the substratum, and put into the envelopes, where it is allowed to dry. Several of these culture envelopes may be sent with little inconvenience in an ordinary letter. It has been the writer's practise as a matter of precaution to sterilize the envelopes either in an autoclav or in a dry oven at 140° C. before using them. The danger of infection is probably not very great if the culture envelopes, although unsterilized, are made up of clean paper that has not been unduly exposed to contamination since the few spores of *Penicillium* or other fungus weeds that may be present have little opportunity of germinating and spreading if the material used in the transfer be rapidly dried and kept in a dry condition. In making up the dry cultures it seems desirable to include some of the substratum mixed with the spores. In this way even such bacteria as *Bacillus prodigiosus* have been successfully sent through the mail and moulds have been received in good condition from as distant countries as the Philippines. Naturally with those fungi that fail to fruit well in captivity and to form spores or other reproductive bodies which retain their vitality, recourse must be had to test-tube cultures with hard agar. The envelope method has been used for several years by the writer and by several of his correspondents, and for the forms most generally cultivated seems to meet

all the requirements of convenience and freedom from contamination.

A. F. BLAKESLEE
CONNECTICUT AGRICULTURAL COLLEGE,
STORRS, CONN.

BOTANICAL NOTES

SANE AND SCIENTIFIC FREE-SEED DISTRIBUTION

IN these days when we hear so much in very proper denunciation of the continuation of the congressional free-seed distribution which the United States Department of Agriculture is annually compelled to make, it is well to call attention to some work now quietly carried on by the Bureau of Plant Industry which is not only not open to such criticism, but, on the contrary, very much to be commended. Through inquiries made by a representative of SCIENCE the following authoritative statements have been elicited, and are here published in order to show the nature and scope of a legitimate seed and plant distribution, in contrast with the annual farce which is enacted at the imperious command of a majority of the congressmen. It is due the department to say that in these statements only a few of the lines of work conducted under the appropriations for "the purchase and distribution of valuable seeds" are mentioned.

FORAGE CROP WORK

Introduction and Extension of Alfalfa.—This work includes the extension of the present range of alfalfa culture in the east and the introduction of new varieties in the west. Special attention is being given to the development of varieties which will resist cold and drought, as well as varieties which will give greater yields than those ordinarily grown. Arabian alfalfa, secured by exploration in 1905, has proved to be by far the heaviest yielder in the southwest. Twelve cuttings were obtained at Mecca, Cal., during the past year as compared with eight cuttings of ordinary alfalfa. This is the most remarkable alfalfa yet found for rapidity of growth.

Propaganda Work with New and Standard Grasses.—This work has for its objects the wider utilization of the standard grasses and the introduction and extension of the culture of new and improved varieties. Experiments with improved varieties of timothy, with meadow and pasture mixtures, and with several new grasses, such as Para grass, Guinea grass, and Natal grass, are being made. During the past year seed has been distributed of the two improved timothies developed by Dr. A. D. Hopkins, both of which possess very superior merit. One of these ripens with red clover and the other is a large yielder.

Cowpea Investigations.—The chief object of this work is to secure cheaper and better cowpea seed, so as to bring about a great increase in cowpea culture. The need is for good varieties producing small, hard seeds that will not crack and that retain their vitality for more than one year. The cowpea is to the south what clover is to the north, and the lessening of the cost of the seed and the improvement of varieties are important problems. Much attention is being given to the study and development of harvesting machinery.

Work with Vetches in the South.—This work consists of the introduction and encouragement of the growing of vetches throughout the south. The vetch is an exceedingly important plant and its much wider use is greatly to be desired. The development of varieties that will mature in time for cotton-planting, and the distribution of seed of desirable varieties are features of the work. About sixty varieties and species of vetch have been tested for two years. One of these, *Vicia dasycarpa,* is of especial promise, resembling hairy vetch, but being so early that it can be used as a winter crop in rotation with cotton. Seed is being grown in quantity. Extensive cooperative experiments with farmers, especially in the south, with common vetch and hairy vetch have been conducted during the past two years, resulting in great interest in the crop and a greatly increased culture. This work is being continued.

Tests of New Forage Crops.—Among the new forage plants under test are the Tangier pea and guar, an East Indian forage plant.

Extensive tests of these plants are being made in various parts of the country, and their culture in promising localities is being encouraged. These tests are being carried on at Arlington, Va.; Chico, Cal.; Pullman, Wash.; and Chillicothe, Tex. Among the most valuable new things so far tested are the Tangier pea, moth bean, and snail clover, all of which are of sufficient promise to warrant distribution. Seed of the first two has been grown in quantity for distribution in 1908.

IMPROVED COTTON SEED

THIS work consists of the sending out on congressional and other order of trial packages of seed of the improved varieties of cotton developed by the plant breeders of the Bureau of Plant Industry for boll-weevil districts. Each congressman from the cotton states is assigned a regular quota of eighty packages of this select seed, each package containing one peck. The seed is also sent to cooperators and others.

IMPROVED TOBACCO SEED

THIS work is conducted on the same plan as the cotton-seed distribution, the improved varieties of tobacco being sent out on both congressional and other request. The Bureau of Plant Industry has developed several improved tobaccos, and the seed secured in the breeding work is distributed each season.

IMPROVED MELON SEED, CITRUS HYBRIDS, ETC.

THE Bureau of Plant Industry also distributes each year seed of improved wilt-resistant melons, which are being developed in connection with the pathological work; and also young trees of improved and new citrus fruits, such as citranges, tangelos, etc.

AGRICULTURAL EXPLORATIONS

THE Bureau of Plant Industry conducts systematic agricultural exploration work in foreign countries. Purchases are made in all parts of the world, including seeds and plants for trial by the experiment stations and others, and the shipments arrive at the rate of eight or nine a day. One of its explorers has completed a year of search through Manchuria and North China for hardy fruits, vegetables, grains and forage crops. He has secured and shipped in over 1,000 things, among them promising new alfalfas, seedless persimmons four inches in diameter, hardy Chinese pears, the Shantung peach for the dry southwest, new North China grapes, the seedless Chinese date, timber bamboos, new cowpeas, new soy beans, a new rose, a new sand cherry, a remarkable series of new shade trees and sorghums, etc. These things are now being tested in those portions of this country which have a climate like that of North China, where the thermometer goes down to 15 or 20 degrees below zero.

DATE INTRODUCTIONS AND DATE GARDENS

A LARGE collection of the remarkable date varieties from the upper Tigris River in the region of Bagdad is now being gotten together by the American consul, and these will be sent to this country next spring. Large purchases of date seeds and fruit of the Morocco varieties have been made this season. Two date gardens are being maintained in California, one at Mecca and the other at Indio. In the Mecca garden are assembled 394 palms imported from foreign countries. They occupy fifteen acres of land and are without doubt the largest ever gotten together in any country. It has been demonstrated that the date palm can be grown successfully in California and Arizona as a result of this work during the last eight years.

MATTING PLANT INTRODUCTION

THE floor-matting industry costs the United States four million dollars in imports every year. There are perfected looms in America which are fed by the imported material—rush and sedge straw. The Americans are being shut out of the Japanese market by the Japanese manufacturers and must get their raw material in this country or take their machines to Japan and operate them there. An explorer was sent to Japan by the Department of Agriculture and secured, notwithstanding the opposition of the Japanese mat-

ting guilds, 75,000 plants of the Japanese rush and 380,000 plants of the Japanese sedge. It was found necessary to increase these quantities by propagation, but car-load lots have now been sent to points in Texas, Louisiana, South Carolina and California, where contracts have been made for the planting of trial areas under normal field conditions.

BAMBOO INTRODUCTION

THE timber bamboos of the Orient are among the most profitable plant cultures of the orientals. Scattering groves of these plants in America have demonstrated that they can be grown profitably on land that is not now occupied by crops, such as the "canebrake" lands of the south. The uses in this country to which bamboos can be put are being studied. Early introductions into the plant introduction garden at Chico, Cal., have been growing successfully and an explorer has been appointed to get up a shipment of the best timber forms and import them the coming spring. Hardier forms than the Japanese have been found in China, drought resistant forms are being ordered from India, and the tropical giant forms will be secured from the planters in Porto Rico.

CHARLES E. BESSEY
THE UNIVERSITY OF NEBRASKA

THE NATIONAL EDUCATIONAL ASSOCIATION

THE National Educational Association meets at Cleveland Ohio, from June 29 to July 3, under the presidency of Mr. Edwin G. Cooley, of Chicago. The program of the general sessions is as follows:

Monday Afternoon, June 29

Addresses of welcome by Hon. Tom L. Johnson, mayor of city of Cleveland, Ohio, and by Dr. Charles S. Howe, president of Chamber of Commerce, Cleveland Ohio.

Response by William O. Thompson, president of Ohio State University, Columbus, Ohio.

Report of Educational Progress for the Year, by Charles F. Thwing, president of Western Reserve University, Cleveland, Ohio.

Monday Evening, June 29

Annual address of the president, Joseph Swain, president of Swarthmore College.

"Compulsory Education in Industries in the Schools of London," by Cloudesley S. H. Brereton, divisional inspector for the London Council, London. (Appointment provisional.)

"Adaptation of the Public School to Industrial Ends," by Andrew S. Draper, commissioner of education for the state of New York, Albany, N. Y.

Tuesday Evening, June 30

"The Rein and Spur," by J. C. Willis, president of Louisville University, Louisville, Ky.

"Negro Education and the Nation," by Booker T. Washington, president of Tuskegee Institute, Tuskegee, Ala.

"The Function of Education in a Democracy," by Martin G. Brumbaugh, superintendent of schools, Philadelphia, Pa.

Wednesday Afternoon, July 1

"Reconcilement of Cross Purposes in Education of Women" by Sarah Louise Arnold, dean of Simmons College, Boston, Mass.

"The School and the Immigrant Child," by Jane Addams, Hull House, Chicago, Ill.

"The School and the Practise of Ethics," by Ella Flagg Young, principal of Chicago Normal School, Chicago, Ill.

Friday Morning, July 3

"The Personal Touch in Teaching," by Andrew F. West, dean of the Graduate School, Princeton University, Princeton, N. J.

"Personal Power of the Teacher in Public School Work," by William H. Maxwell, superintendent of schools, New York City.

Those announced to read papers before the department of higher education are the president of the department, Dr. Oscar J. Craig, and Professors R. J. Alley, Charles Fordyce, David S. Snedden, W. H. Crawford and W. N. Stearns. Those announced to read papers before the department of science instruction are Messrs. R. H. Whitbeck, N. M. Fenniman, Robert A. Millikan and Miss Martha K. Genthe. An evening session will be addressed by Professor L. H. Bailey and Mr. Gifford Pinchot.

THE HANOVER MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

WITH the issue of SCIENCE for May 29 there was distributed the preliminary announcement of the special summer meeting of the as-

sociation to be held on the invitation of Dartmouth College, at Hanover, N. H., from June 29 to July 3. The American Physical Society and the Geological Society of America meet in affiliation with the association, and good programs of scientific papers may be expected in physics and in geology. In the other sciences there will be no regular programs, though there may be informal conferences. The special feature of the meeting will be the opportunity of meeting colleagues and friends amid the pleasant surroundings of a New England College and the interesting excursions that have been arranged. Those who were able to attend the summer meeting at Cornell University two years ago remember it with special pleasure, and there is every reason to believe that the meeting at Dartmouth College this year will prove equally attractive.

The association is performing an important service for scientific men and for those interested in science by arranging not only great winter meetings in our cities where the attendance runs into the thousands and where the collective strength of the science of the country is exhibited, but also in providing less formal meetings in the summer for those able to attend them. Our scientific men are so many, the country is so large and interests are so diversified that there is ample room for two meetings in different regions and of different character. There is indeed nothing quixotic in looking forward to the time when the association will make arrangements for a dozen meetings in the course of a year. It is an advantage to have a well-organized central office which will serve scientific men and scientific interests whenever and wherever this is possible. Our national societies devoted to the different sciences, and our local academies must be the units of organization; and their complete autonomy must be respected. But each of these societies can not maintain salaried officers and have at its disposal the information and the experience which are needed to arrange a meeting efficiently and economically.

In arranging the Hanover meeting the officers of the association have served the physicists and the geologists, who wish to hold sessions, and have provided a center where scientific men can meet individually and in conferences and committees. They have also performed a function which has been somewhat neglected in recent years, and which has never been so well performed here as in Great Britain, namely, the diffusion of science and the awakening of the interest of those not professionally engaged in scientific work. It should always be remembered that science depends on the intelligent public for recruits and for support, and scientific men should encourage general interest in science in so far as this can be done without sacrifice of their research work. A meeting such as this at Hanover should attract men and women who wish to become acquainted with the work of scientific men. Relatively more attention can and should be paid to their interests than is possible in the crowded winter meetings. Lectures, meetings and excursions have been arranged at Hanover which are of general interest, and this fact should be brought by scientific men to the attention of others.

While the Hanover meeting may interest directly only a small proportion of the scientific men of the country, it certainly does not interfere with those who do not attend. On the contrary, it is of some service to all by what it does accomplish. Next summer the British Association meets in Winnipeg, and has courteously invited all members of the American Association to become members for

the meeting. An invitation of this character could only be extended to a national association. For the following summer the officers of the association are planning an excursion to Hawaii and a meeting there. The association in thus serving the interests of scientific men and of those interested in science in both summer and winter deserves the support of all, and this can be best given at present by attending the Hanover meeting. Each one who goes will add to the pleasure of others, and will find himself amply repaid.

SCIENTIFIC NOTES AND NEWS

FOLLOWING the conference of the governors at the White House, President Roosevelt has appointed a National Conservation Commission, divided into sections for waters, forests, lands and minerals. Mr. Gifford Pinchot, chief forester, is chairman of the commission, which, in addition to senators and representatives, includes Dr. W J McGee, Mr. F. H. Newell, Professor George F. Swain, Professor Henry S. Graves, Mr. Overton W. Price, Mr. Charles McDonald, President Charles R. Van Hise, Mr. John Hays Hammond, Professor Irving Fisher and Mr. J. A. Holmes.

PROFESSOR LIBERTY H. BAILEY, director of the College of Agriculture at Cornell University, has been given the degree of doctor of laws by Alfred University, where he made a commencement address.

THE University of Cincinnati has conferred its doctorate of laws on Dr. F. C. Shattuck, Jackson professor of clinical medicine in the Harvard Medical School.

THE University of Arizona conferred the degree of LL.D. on Professor William Phipps Blake, at its annual commencement on June 3, in recognition of his achievements in exploration and geology. Professor Blake began his work in the southwest as a member of the Williamson expedition which traversed southern California and the Colorado desert in 1852, discovering the San Gorgonio Pass and making clear the nature of the Salton Basin.

SIR GEORGE DARWIN, K.C.B., F.R.S., and Professor E. B. Tylor, F.R.S., have been elected corresponding members of the Vienna Academy of Sciences.

AN expedition, under the combined auspices of the American Museum of Natural History and the Geological Survey of Canada, is now on its way to the mouth of the Mackenzie River and adjacent country to collect ethnological and zoological material. The party is being conducted by Mr. V. Stefánsson, who is well acquainted with the Eskimos of the region, having wintered with them in 1906, and Mr. R. M. Anderson, a well-known naturalist. The expedition was organized for the purpose of making scientific studies of the Eskimos of the country, of procuring as exhaustive collections as possible illustrating not only the material cultures of the uncivilized tribes of the region, but also of the zoological conditions which prevail there, and of increasing our knowledge of the geological formation of that portion of the world. The expedition will commence its return journey during the summer of 1909.

MR. FRANK M. CHAPMAN on his recent ornithological expedition for the American Museum of Natural History procured material for a "habitat group" illustrating the rookery bird life, at one time so characteristic a feature of Florida. He succeeded in reaching doubtless the last general rookery of the region. The museum group will contain large and small White Egrets, Roseate Spoonbills, Louisiana and Blue Herons and White Ibises. Mr. Chapman also secured a series of moving pictures of pelicans on Pelican Island, showing the habits of the birds during the nesting period. These pictures will be of especial interest, as evidencing the results of the protection which has been accorded the birds for the past five years.

IN compliance with a request of the secretary of the interior, Dr. J. Walter Fewkes, of the Bureau of American Ethnology of the Smithsonian Institution, has gone to the Mesa Verde National Park, Mancos, Colorado, to take charge of the excavation and preservation of the cliff dwellings there. His work

for the present will be directed toward the so-called Spruce Tree House, which he will restore, before attempting the preservation of the Cliff Palace. The Cliff Palace is not only the finest but also the largest example of cliff house architecture in our southwest. In the Cliff Palace, Dr. Fewkes plans to excavate all the rooms and plazas to their floors, remove accumulated débris, repair the walls that are in danger of falling, and put the ruin in such a condition that a visitor may walk through the courts and rooms without obstruction. Dr. Fewkes has gone to the Mesa Verde Park from the Casa Grande ruin, Pinal County, Arizona, where he has been at work during the winter season unearthing the remains of an extensive prehistoric city.

Professor C. J. Chamberlain visited Mexico during March and April to continue his studies upon the Mexican cycads. Besides securing abundant material and numerous photographs of *Dioon edule* and *D. spinulosum,* he found at Santa Catarina in the state of Oaxaca a new species of *Dioon* which is clearly intermediate between the other two species, having the habit of *D. edule* with the spinulose leaf of *D. spinulosum*. The leaf is not so spinulose, however, as in *D. spinulosum*. Further observations were also made upon *Ceratozamia*.

Professor E. D. Campbell, director of the chemical laboratories of the University of Michigan, recently visited the University of Wisconsin and delivered an address to the faculty and students of the chemistry department on "Technical Chemistry." Sigma Xi, the honorary scientific society, entertained Professor Campbell at a banquet at which he gave a second address on "The Effect of Free Magnesia on Cements." Through an accident in 1891 Professor Campbell lost his sight; but in spite of the fact he has risen to his present high position, doing considerable valuable original research work, especially on the chemistry of cement and iron. Many of his pupils now occupy responsible positions in university faculties, among them Professor E. B. Hart, head of the department of agricultural chemistry and Professor Richard Fischer, of the chemistry department of the University of Wisconsin.

An effort is being made to erect at Montpellier, France, on the grounds of the National School of Agriculture, a monument to the late Gustave Foëx, the French horticulturist whose work on the grapevine *Phylloxera* and other viticultural questions is so well known to the horticultural world. A considerable amount of money has been raised in Europe, and the committee hopes to obtain something in America between the present date and the end of next September. Americans desirous of contributing any sum, large or small, may do so by addressing the Comité d'Organisation, Monument Gustave Foëx, Montpellier, France, or the American representative of the Committee, Dr. L. O. Howard, U. S. Department of Agriculture, Washington, D. C.

A statue of Liebig is to be erected in Darmstadt, where he was born in 1803. The corporation of Darmstadt has contributed 3,000 Marks towards the expenses.

Sir John Evans, K.C.B., F.R.S., the eminent British archeologist, past president of the British Association for the Advancement of Science, died at his residence, Britwell, Berkhampsted, on May 31, in his eighty-fifth year.

Dr. Oskar Langendorf, professor of physiology at Rostock, has died at the age of fifty-five years.

The deaths are also announced of Dr. A. Belohoubek, professor of pharmaceutical chemistry in Prague, of Dr. Hermann Wedding, professor of mining at Berlin, and of Dr. Ulrich Behn, docent for physics at Berlin.

There will be a New York State civil service examination for the chief of division of Trade Schools in the Educational Department at a salary which may be $3,000, and for vice-director of the New York Library School, at a salary which may be $2,500. The latter position is open to both men and women. Applications for these two positions will be received until July 1, 1908. A special circular of requirements will be sent on request.

CONGRESS has made an appropriation of $35,000 to pay the expenses of a delegation from the United States to the fourth Latin-American Scientific Congress, which will be held in Santiago, Chile, in December, 1908. The United States is entitled to nine delegates, who will be probably selected from the universities of the country during the present summer. The program divides the work of the congress into the following sections: (1) pure and applied mathematics, including engineering; (2) physical sciences; (3) natural sciences; (4) medicine and hygiene; (5) jurisprudence, political and social science; (6) history, languages and fine arts; (7) pedagogy; (8) agriculture and animal husbandry; (9) industrial processes.

A CABLEGRAM has been received at the Harvard College Observatory from the Astronomische Centrale at Kiel, stating that Encke's comet was observed by Woodgale (Woodgate) at the Cape of Good Hope on May 27, 1908. 691 Gr. M. T. in R. A. 2^h 59^m 16^s. Dec., 7° 29′.

THE *Journal of the American Medical Association* says: "From the outset the Chicago session demonstrated that it would be all that had been expected of it. Registration began the first thing on Monday morning and kept up in a steady stream all day, so that by the time the registration bureau closed 2,210 had registered, a number exceeding the phenomenal Monday's registration at Boston in 1906 by 663. As we go to press (Wednesday noon) the egistration has reached a total of 5,944. In point of attendance, therefore, the Chicago session of 1908 has set a fresh standard for the annual sessions. Last year the total registration reached 3,713, and the Boston session, which had the largest attendance of any preceding the present one, was 4,722. The section meetings are wonderfully well attended, and the meeting places are proving decidedly satisfactory. It is not too much to say that the fifty-ninth annual session of the American Medical Association, held in its home city, will go on record as a permanent milestone in the onward and irresistible march of American medicine."

REPRESENTATIVES of twenty of the state geological surveys meeting in Washington on May 13 organized an Association of American State Geologists. Provision was made for an annual meeting and the appointment of various committees for the transaction of the business of the association. H. B. Kümmel, of New Jersey, was made president, H. F. Bain, of Illinois, secretary, and J. H. Pratt, of North Carolina, was appointed to act with them, forming an executive committee. Messrs. W. B. Clark, of Maryland; I. C. White, of West Virginia, and J. H. Pratt were appointed a committee to investigate the distribution of documents by the various surveys. J. M. Clarke, of New York, was appointed to represent the state geologists on the general committee on nomenclature now being organized, with Samuel Calvin, of Iowa, and E. A. Smith, of Alabama, as associates. The following resolution was unanimously adopted:

Washington, D. C., May 12, 1908.

WHEREAS, our country and the sovereign states composing it now face serious problems relating to the preservation of our national resources, and,

WHEREAS, these problems—of wisely administering our forests, our minerals, our soils, our water resources—are to-morrow to be the subject of a conference between the Governors of the various states and the President of the United States, and,

WHEREAS, we deem a contour-topographic map of our country so necessary to the intelligent solution of these and equally important problems,

Be it *Resolved*, that we most earnestly ask of the state and federal authorities in conference assembled their support in securing such a map, and, since the state and national interests are here so closely one, we most respectfully suggest: That state and federal appropriations for topographic surveys be increased, and that more immediately the federal appropriation be increased for this work to meet the state appropriations now available.

Be it *Resolved*, also, that a copy of these resolutions be presented to said conference of the Governors with President Roosevelt with our greetings and respect.

THE *Journal of the American Medical Association* quotes an announcement to the effect that the German authorities have or-

ganized a central institute at Hamburg to train officials for the German colonies and protectorates, and to centralize all the scientific and economic efforts on behalf of the colonies. In order to keep the institution in close touch with commercial interests, three members of the chamber of commerce are delegated to act as an advisory board in all questions that may arise, and as the intermediary between the institute and the senate commission. Chairs are to be organized for astronomy, botany, geography, geology, history, jurisprudence, tropical medicine, ethnology, political economy and zoology in their relations to the colonies, with all the practical branches of these sciences. The Imperial Colonial Office is to send to the institute at least 20 officials each year for an annual course of instruction, and pay for each about $45 the semester. The lectures are open to merchants and others, and a special diploma is given to all those who complete the course. The city of Hamburg at present bears the cost of maintenance, but state aid is guaranteed in case the scope of the institute is enlarged or it develops beyond the present facilities. The term commences on October 1, 1908.

THE Athens correspondent of the London *Times* reports that two archeological discoveries of considerable importance have been made. The excavations carried out in the Altis or sacred precincts of Olympia, near the great altar of Zeus, under the superintendence of Professor Dorpfeld, have resulted in the discovery of interesting remains of the Neolithic period, including house-vessels and implements. Thus it is evident that Olympia was a place of human habitation more than two thousand years before Christ. In Sparta the members of the British School have brought to light a large number of interesting terra-cotta figurines of the fifth century before Christ.

UNIVERSITY AND EDUCATIONAL NEWS

THE University of Rochester has practically completed a fund of $100,000; thus entitling it to the additional gift of an equal sum from Mr. Andrew Carnegie. Half of the money is to be used for the erection of a building of applied science, and the other half for its endowment.

THE department of physics of the University of Cincinnati has been granted $500 by the Bache Fund for the purchase of apparatus for research.

DR. JOHN S. STAHR has resigned the presidency of Franklin and Marshall College, Lancaster, Pa., which he has held for the past eighteen years.

DR. HORATIO H. NEWMAN has recently resigned an assistant professorship of zoology at the University of Michigan in order to accept the professorship of zoology at the University of Texas, vacant by the removal of Dr. T. H. Montgomery, Jr., to the University of Pennsylvania. Dr. J. T. Paterson, of the University of Chicago, has been appointed instructor in zoology in the same department.

THE following changes have been made at the Iowa State College, Ames: Professor S. W. Beyer is made vice-dean of the division of engineering; Associate Professor M. L. Bowman is made professor of farm crops; Assistant Professor M. P. Cleghorn is made associate professor of mechanical engineering; Assistant Professor R. E. Buchanan is made associate professor of general bacteriology; Professor Maria Boberts is made vice-dean of the junior college; M. I. Evinger is promoted from instructor to assistant professor in civil engineering; H. S. Bell and B. W. Crossley are made assistant professors in farm crops; H. C. Pierce is made assistant professor in animal husbandry in charge of the poultry department.

MR. R. N. RUDMOSE BROWN, B.Sc., has been appointed at Sheffield to the newly-instituted lectureship in geography. Mr. Brown accompanied the Scottish Antarctic Expedition in 1902 as naturalist. He acted in 1906 as special commissioner under the Indian government for the investigation of the pearl oyster fisheries.

GONVILLE and Caius College, Cambridge, has established a new fellowship, to be called the Monro Fellowship, and Mr. T. B. Wood, M.A., Draper's professor of agriculture, has been elected to it.